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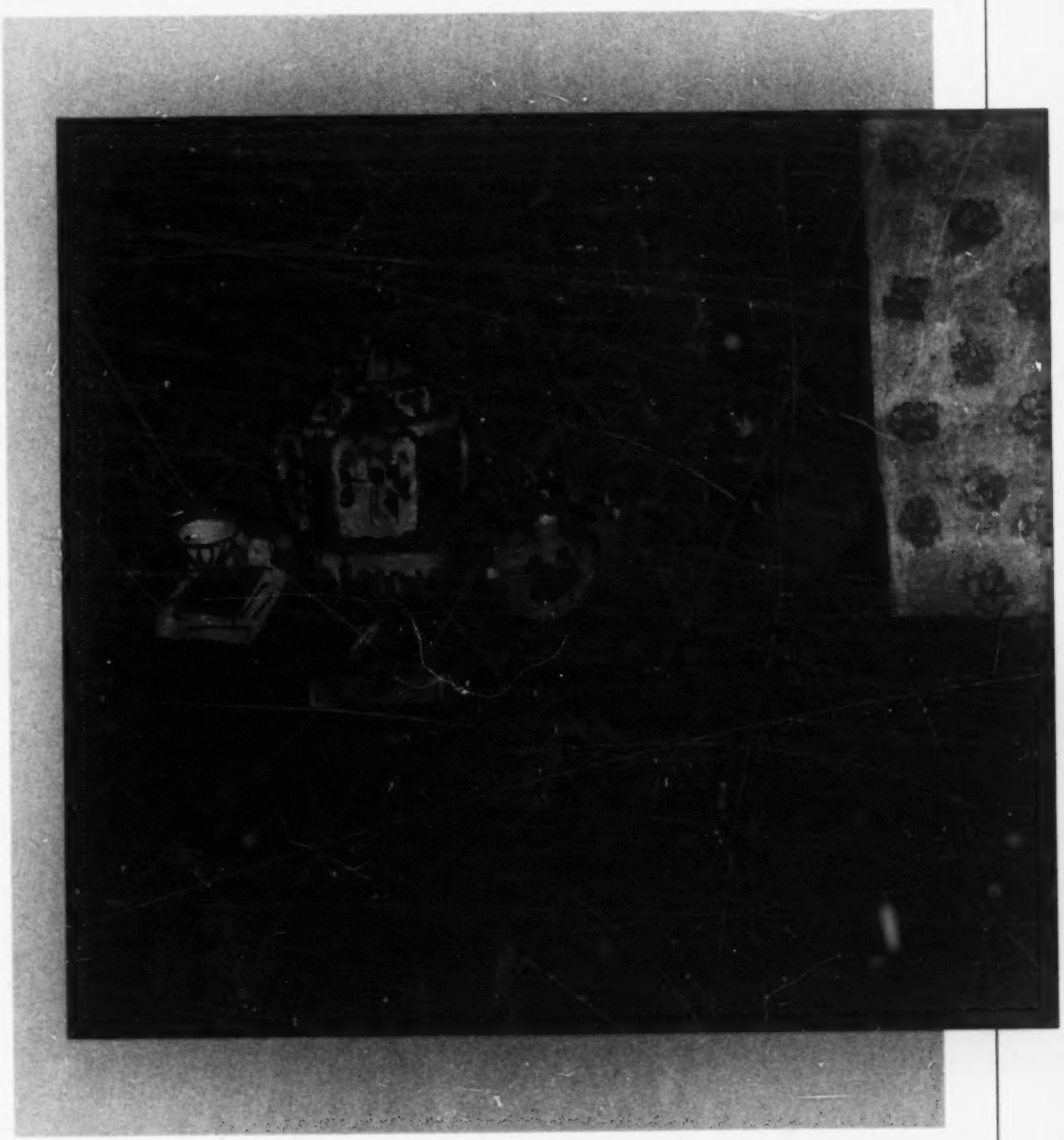

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VBPA

# Special Report

## Rabies surveillance in the United States during 1990

Iyorlumun J. Uhaa, DVM, PhD; Eric J. Mandel, MS; Ruth Whiteway; Daniel B. Fishbein, MD

**Summary**: *In 1990, the United States and its territories reported 4,881 cases of rabies in animals to the Centers for Disease Control, a 1.5% increase from 1989. Of these, 553 were domestic animals, 4,327 were wild animals, and one was a human being. Pennsylvania reported the highest number (611) of rabies cases in animals in 1990. For the first time since surveillance of rabies in wild animals was begun in the 1950s, the number of cases of rabies in raccoons exceeded that in skunks. Particularly large increases of cases of rabies in wild and domestic animals were reported in New Jersey (469 cases in 1990 compared with 50 cases in 1989, an increase of 838% from 1989) and New York (242 cases in 1990 compared with 54 cases in 1989, an increase of 348%). The 1,821 cases of rabies in raccoons represented a 17.9% increase over those reported in 1989 and 24.5% over those in 1988. This increase was largely attributable to the larger number of rabid raccoons in New Jersey and New York. Other states that reported an increased number of rabies cases in animals in 1990 included Utah (77.8%), Louisiana (64.7%), North Dakota (60.3%), Arizona (28.6%), Oklahoma (27.5%), Delaware (22.2%), and Maryland (20.6%). Thirty states reported a decrease in the number of cases of rabies in animals.*

Since the 1960s, rabies has been reported more frequently in wild animals than in domestic animals, with rabies in wild animals accounting for 89% of all cases reported to the Centers for Disease Control (CDC) between 1980 and 1989 (Fig 1). The most frequently reported rabid wild animals have been skunks, raccoons, bats, and foxes. Five rabies epizootics are currently recognized in the United States: two attributable primarily to raccoons (southeastern and the mid-Atlantic states), and three attributable to skunks (North and South Central states, and Northern California).[1]

The mid-Atlantic raccoon epizootic originated in the late 1970s by the transport of raccoons incubating rabies from the southeast United States into the mid-Atlantic region.[2] This epizootic has continued to spread northward and westward into all of Virginia, West Virginia, Maryland, Pennsylvania, New Jersey, New York, and most recently into Connecticut and North Carolina (Fig 2).

This report was prepared to update the 1989 report[3] on rabies in animals and to provide information on trends in rabies in the United States, Canada, and Mexico for 1990. Emphasis will be given to the species involved, geographic distribution, and secular trends in epizootics and their relationships to public health.

### Collection of data

The method used to collect data was similar to that used by Reid-Sanden et al.[3] Briefly, between Jan 1 and Dec 31, 1990, all 50 states, the District of Columbia, and Puerto Rico reported all laboratory-confirmed cases of rabies in animals to the Centers for Disease Control. Forty-six states submitted data monthly on the number of rabies cases, stratified by county of origin and species. Five states submitted data via the National Electronic Telecommunications System for Surveillance. All diagnoses of rabies in animals were made on the basis of a positive result of the direct fluorescent-antibody test on brain tissue by state health department laboratories. Virus isolation in mice or in neuroblastoma cells were sometimes performed to confirm results of the direct fluorescent-antibody test. All data were verified and confirmed for accuracy with individual state health departments. Data from Canada and Mexico were obtained from the Animal Health Division, Canadian Department of Agriculture, and from the Direccion General de Medicina Preventiva, Secretaria de Salud, Mexico.

### Rabies in wild animals

Wild animals continued to account for most

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The authors thank James G. Dobbins (National Center for Infectious Diseases, Centers for Disease Control) and the state and territorial health and agriculture departments of the United States for their contributions.

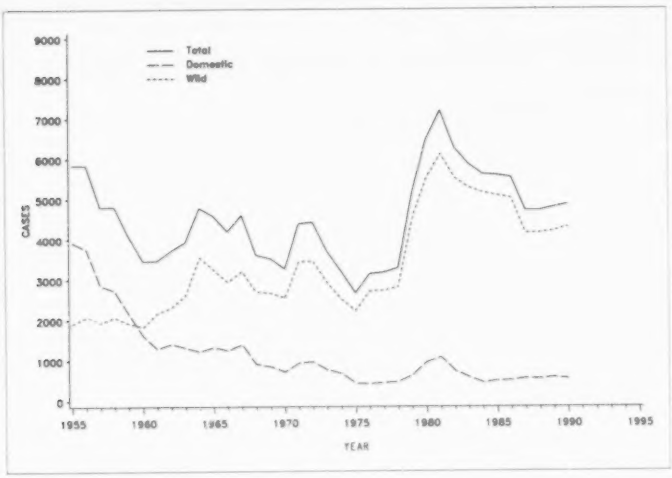


*Figure 1—Cases of animal rabies in the United States, by year, 1955 to 1990.*

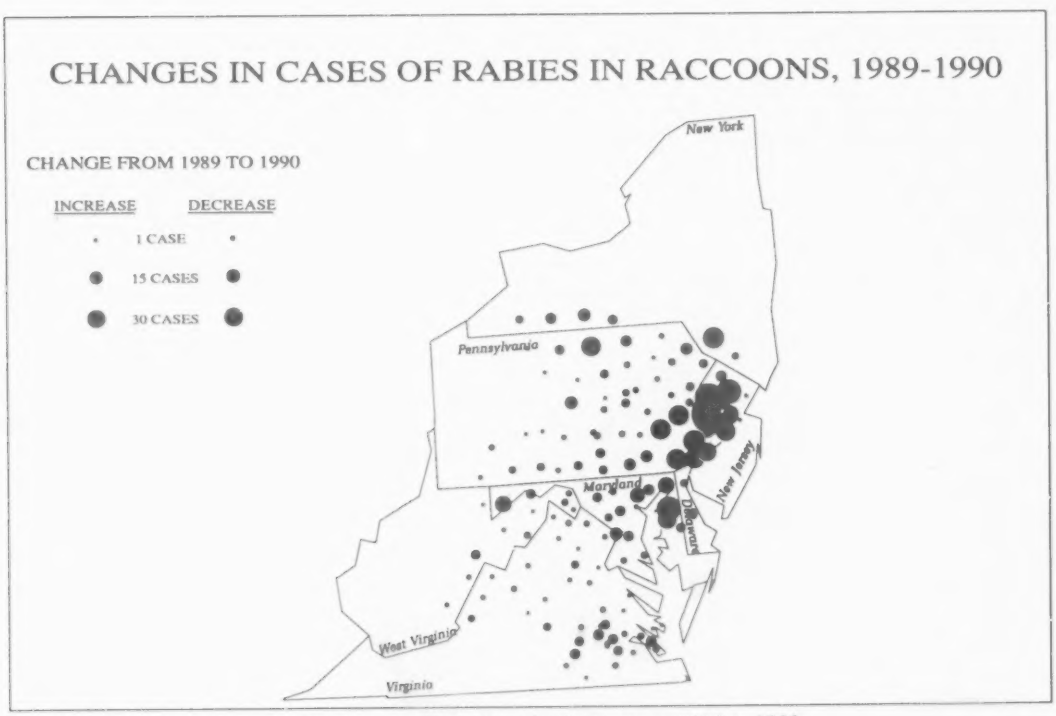


*Figure 2—Changes in cases of rabies in raccoons in the mid-Atlantic states, 1989 to 1990.*

(88.6%) reported cases (Fig 1). In 1990, 4,327 cases of rabies in wild animals were reported, a 2.4% increase over the 4,224 cases reported in 1989 (Table 1). The majority of cases (86.8%) were reported from disease reservoirs in raccoons, skunks, foxes, and bats. Only raccoon cases increased in number (1,821 cases), a 17.9% increase from 1989. Raccoon cases exceeded skunk cases for the first time since surveillance of rabid wild animals was initiated in the 1950s (Fig 3). The other three major wild animal reservoirs decreased in number: skunks by 4.7%, foxes by 4.8%, and bats by 12%.

*Raccoons*—The 1,821 cases of rabies in raccoons reported in 1990 was the largest number of cases reported since 1983, when 1,906 cases were reported. Delaware, Maryland, New Jersey, New York, Pennsylvania, and Virginia reported 1,445 (79.4%) of the total number of raccoon cases, whereas the southeastern states of Alabama, Florida, Georgia, and South Carolina reported 342 cases (18.8%). The distribution of rabies in raccoons in the United States in 1990 shows that urban and suburban areas continue to be intensely affected (Fig 4). The epizootic moved into the state of New York with 84 new cases of rabies in

*Table 1—Cases of rabies, by state and category in the United States during 1990*

| State | All animals | Domestic | Wild | Domestic animals | | | | | | Wild animals | | | | | | Human being | 1989 | Percentage change‡ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dogs | Cats | Cattle | Horses/ mules | Sheep/ goats | Swine | Skunks | Foxes | Bats | Raccoons | Rodents and lagomorphs* | Other wild† | | | |
| Total | 4,881 | 553 | 4,327 | 148 | 176 | 173 | 45 | 9 | 2 | 1,579 | 197 | 637 | 1,821 | 28 | 65 | 1 | 4,809 | 1.5 |
| AL | 90 | 16 | 74 | 7 | 9 | | | | | 2 | 8 | 8 | 54 | 1a | 1e | | 117 | −23.1 |
| AK | 26 | 0 | 26 | | | | | | | | 23 | | | | 3f | | 71 | −63.4 |
| AZ | 36 | 3 | 33 | | 3 | | | | | 8 | | 25 | | | | | 28 | 28.6 |
| AR | 39 | 2 | 37 | | | 1 | 1 | | | 28 | | 9 | | | | | 89 | −56.2 |
| CA | 361 | 11 | 350 | 3 | 3 | 1 | 2 | 2 | | 230 | 10 | 105 | | | 5g | | 395 | −8.5 |
| CO | 23 | 0 | 23 | | | | | | | | | 23 | | | | | 34 | −32.4 |
| CT | 3 | 0 | 3 | | | | | | | | | 3 | | | | | 3 | 0.0 |
| DC | 8 | 0 | 8 | | | | | | | | | | 8 | | | | 12 | |
| DE | 44 | 0 | 44 | | | | | | | 5 | 1 | | 37 | 1b | | | 36 | 22.2 |
| FL | 99 | 6 | 93 | 2 | 4 | | | | | 2 | 5 | 19 | 63 | | 4h | | 190 | −47.9 |
| GA | 202 | 16 | 186 | 9 | 4 | 1 | 2 | | | 20 | 12 | 8 | 143 | | 3i | | 233 | −13.3 |
| HI | 0 | 0 | 0 | | | | | | | | | | | | | | 11 | −36.4 |
| ID | 7 | 0 | 7 | | | | | | | | | 7 | | | | | 29 | 3.4 |
| IL | 30 | 2 | 28 | | | 2 | | | | 17 | | 11 | | | | | 22 | −36.4 |
| IN | 14 | 1 | 13 | | | | 1 | | | | 1 | 12 | | | | | 203 | 5.9 |
| IO | 215 | 78 | 137 | 12 | 19 | 35 | 10 | 2 | | 122 | | 11 | 3 | 1b | | | 59 | −23.7 |
| KS | 45 | 3 | 42 | | 1 | | 2 | | | 37 | | 5 | | | | | 134 | −58.2 |
| KY | 56 | 13 | 43 | 9 | 1 | 3 | | | | 35 | 4 | 4 | | | | | 17 | 64.7 |
| LA | 28 | 0 | 28 | | | | | | | 27 | | 1 | | | | | 2 | −50.0 |
| ME | 1 | 0 | 1 | | | | | | | | | 1 | | | | | 388 | 20.6 |
| MD | 468 | 15 | 453 | 1 | 11 | 2 | 1 | horse | | 35 | 17 | 14 | 382 | 4b | 1j | | 5 | 100.0 |
| MA | 10 | 0 | 10 | | | | | | | | | 10 | | | | | 29 | 75.9 |
| MI | 51 | 3 | 48 | | 3 | | | | | 1 | 1 | 46 | | | | | 149 | 58.4 |
| MN | 236 | 53 | 183 | 15 | 11 | 23 | 4 | | | 164 | 1 | 17 | 1 | | | | 4 | −25.0 |
| MS | 3 | 0 | 3 | | | | | | | | | 3 | | | | | 62 | −51.6 |
| MO | 30 | 6 | 24 | 4 | | 1 | 1 | | | 12 | | 12 | | | | | 71 | −33.8 |
| MT | 47 | 4 | 43 | | | 4 | | | | 27 | | 16 | | | | | 33 | −84.8 |
| NE | 5 | 1 | 4 | 1 | | | | | | 4 | | | | | | | 9 | 100.0 |
| NV | 18 | 1 | 17 | | | 1 | | | | | | 17 | | | | | 2 | 50.0 |
| NH | 3 | 0 | 3 | | | | | | | | | 2 | 1 | | | | 50 | 838.0 |
| NJ | 469 | 10 | 459 | | 8 | 1 | | 1 | | 30 | 1 | 9 | 408 | 9c | 2k | | 21 | −33.3 |
| NM | 14 | 0 | 14 | | | | | | | 7 | | 7 | | | | | 54 | 348.1 |
| NY | 242 | 17 | 225 | 2 | 1 | 14 | | | | 23 | 34 | 84 | 84 | | | | 9 | 0.0 |
| NC | 9 | 0 | 9 | | | | | | | 3 | | 6 | | | | | 58 | 60.3 |
| ND | 93 | 26 | 67 | 6 | 2 | 17 | 1 | | | 66 | | | | 1b | | | 14 | −28.6 |
| OH | 10 | 1 | 9 | | | | 1 | | | | 1 | 8 | | | | | 102 | 27.5 |
| OK | 130 | 18 | 112 | 3 | 10 | 4 | 1 | | | 107 | | 5 | | | | | 6 | −83.3 |
| OR | 1 | 0 | 1 | | | | | | | | | 1 | | | | | 702 | −13.0 |
| PA | 611 | 47 | 564 | | 34 | 8 | 5 | | | 102 | 29 | 19 | 405 | 8b | 11 | | 84 | −34.5 |
| PR | 55 | 22 | 33 | 11 | 5 | 5 | | 1 | | | | | | | 33m | | 1 | −100.0 |
| RI | 0 | 0 | 0 | | | | | | | | | | | | | | 192 | −32.3 |
| SC | 130 | 8 | 122 | 1 | 6 | | 1 | | | 20 | 13 | 4 | 82 | | 31 | | 125 | 67.2 |
| SD | 209 | 56 | 153 | 11 | 8 | 31 | 4 | | 2 | 145 | 1 | 6 | | 1d | | | 87 | −33.3 |
| TN | 58 | 4 | 54 | 4 | | | | | | 43 | 3 | 6 | 2 | | | | 406 | −35.0 |
| TX | 264 | 68 | 195 | 40 | 14 | 6 | 5 | 3 | | 117 | 24 | 45 | 2 | | 7n | 1 | 9 | 77.8 |
| UT | 16 | 1 | 15 | | 1 | | | | | | | 15 | | | | | 1 | −100.0 |
| VT | 0 | 0 | 0 | | | | | | | | | | | | | | 262 | −22.9 |
| VA | 202 | 16 | 186 | 1 | 11 | 3 | 1 | | | 42 | 8 | 6 | 129 | | 11 | | 9 | −55.6 |
| WA | 4 | 0 | 4 | | | | | | | | | 4 | | | | | 48 | −16.7 |
| WV | 40 | 4 | 36 | 1 | 3 | | | | | 14 | | 5 | 17 | | | | 55 | 27.3 |
| WI | 70 | 19 | 51 | 4 | 3 | 10 | 2 | | | 37 | | 12 | | 2b | | | 77 | −27.3 |
| WY | 56 | 2 | 54 | 1 | 1 | | | | | 47 | | 6 | | | 1p | | | |
| Percentage‡ | 100 | 11.33 | 88.65 | 3.03 | 3.61 | 3.54 | 0.92 | 0.18 | 0.04 | 32.35 | 4.04 | 13.1 | 37.31 | 0.57 | 1.33 | 0.02 | 100 | |
| Total 1989§ | 4,809 | 584 | 4,224 | 160 | 212 | 151 | 51 | 8 | 1 | 1,657 | 207 | 720 | 1,544 | 21 | 75 | 1 | | |
| % change‖ | 1.5 | −5.31 | 2.44 | −7.5 | −17 | 14.57 | −11.765 | 12.5 | 100 | −4.707 | −4.83 | −12 | 17.9 | 33.33 | −13.3 | 0 | | |

*Rodents and lagomorphs include: (a) 1 squirrel; (b) 17 groundhogs; (c) 8 groundhogs, 1 rabbit; (d) 1 shrew. †Other wild includes: (e) 1 opossum; (f) 3 wolves; (g) 2 bobcats, 1 opossum, 2 coyotes; (h) 1 otter, 3 bobcats; (i) 2 coyotes, 1 bobcat; (j) 1 otter; (k) 2 deer; (l) 5 bobcats; (m) 33 mongooses; (n) 3 coyotes, 4 bobcats; (p) 1 coyote. ‡Percentage of all rabid animals in 1990. §1989 total by species. ‖Percentage change from 1989.

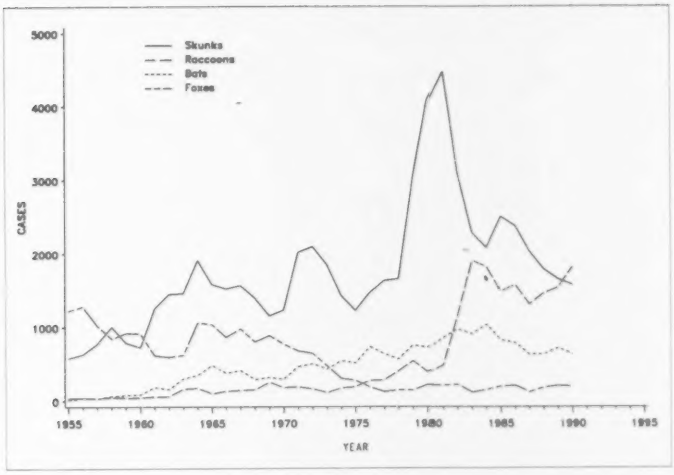


*Figure 3—Cases of rabies in wild animals in the United States, by year and species, 1955 to 1990.*

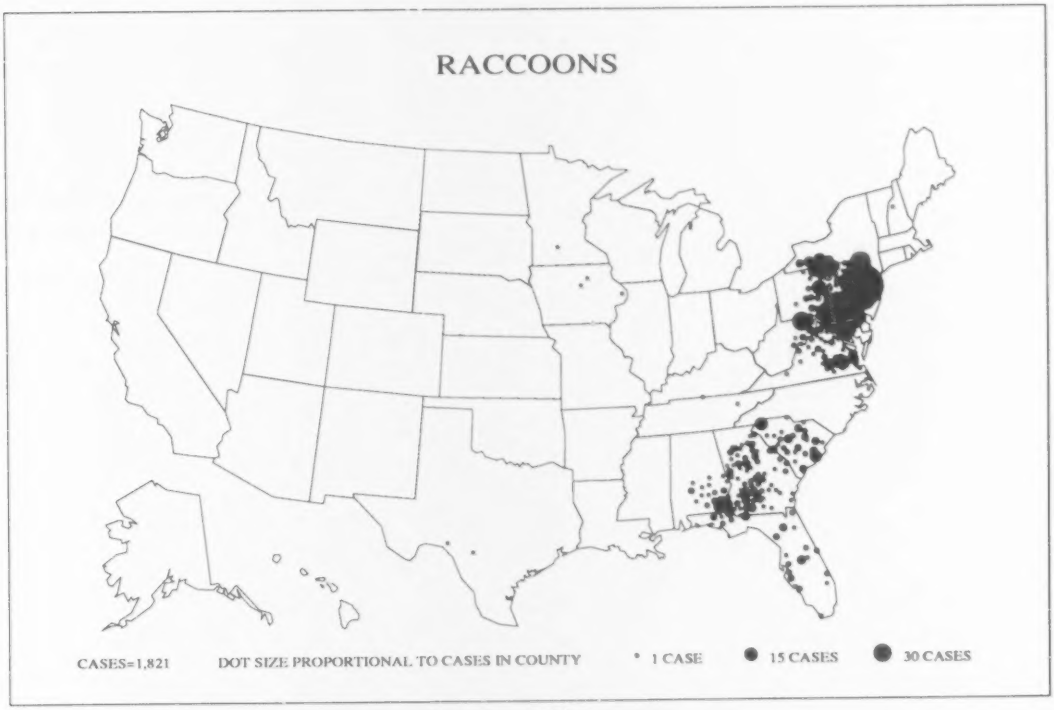


*Figure 4—Reported cases of rabies in raccoons, by county, 1990.*

raccoons reported in 1990. New Jersey reported the highest number of rabid raccoons (408) in 1990, a 22.6-fold increase in the state since the first 18 cases were reported in 1989. By Dec 31, 1990, six counties were affected by the epizootic in New Jersey, up from two counties in 1989. The epizootic has spread in New Jersey at the rate of approximately 25 km/yr. Pennsylvania reported 405 rabid raccoons, a 17.8% decrease from 1989; Virginia reported 129 cases in 1990, a 12.8% decrease from 1989. Other states affected by the epizootic that reported increases were Delaware (76.2%) and Maryland (29.5%). Florida, Alabama, and Georgia reported substantial decreases in the number of rabid raccoons.

*Skunks*—Rabies in skunks remained enzootic in most midwestern states and in California (Fig 5). In 1990, 1,579 cases of rabies in skunks were reported to the CDC, a decrease of 4.7% from 1989. However, substantial increases in the number of rabid skunks were reported from adjacent midwestern states: North Dakota (66 cases, an increase of 83.3% from 1989), Minnesota (164 cases, an increase of 65.7%), and South Dakota (145 cases, an increase of 61.1%). Together with Iowa (122

*Figure 5—Reported cases of rabies in skunks, by county, 1990.*

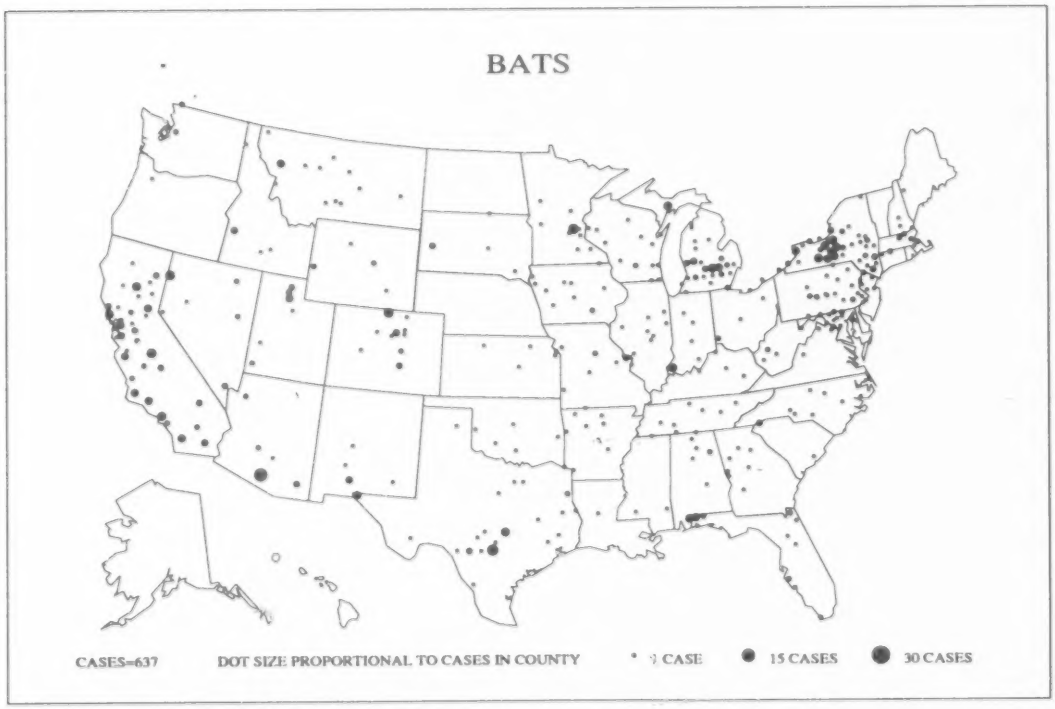


*Figure 6—Reported cases of rabies in bats, by county, 1990.*

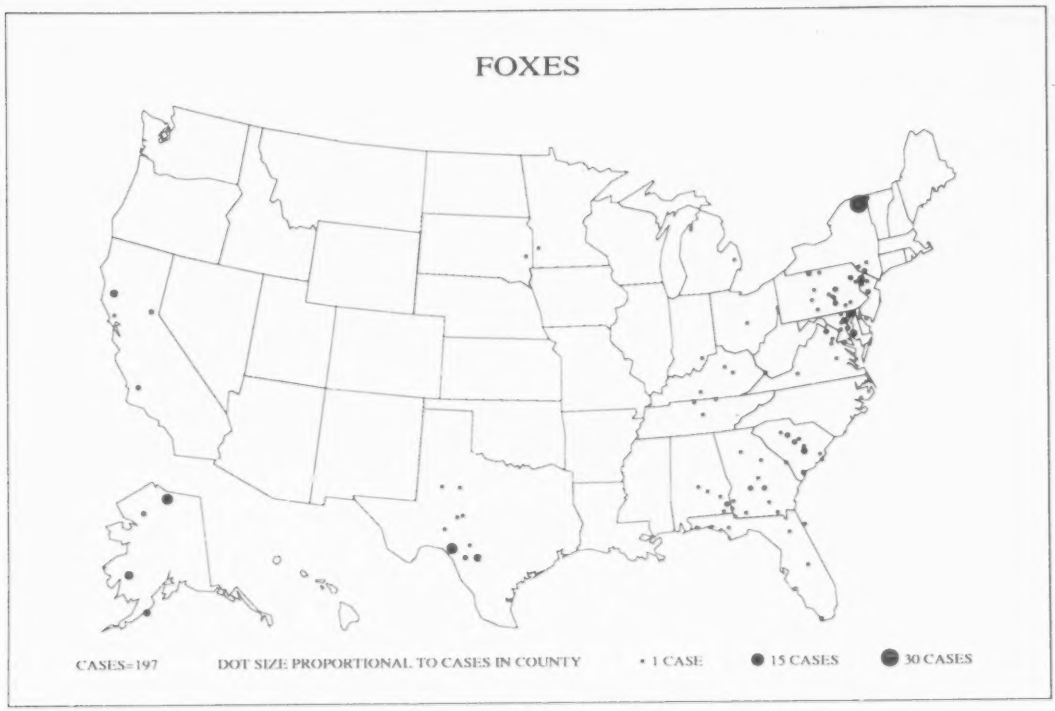


*Figure 7—Reported cases of rabies in foxes, by county, 1990.*

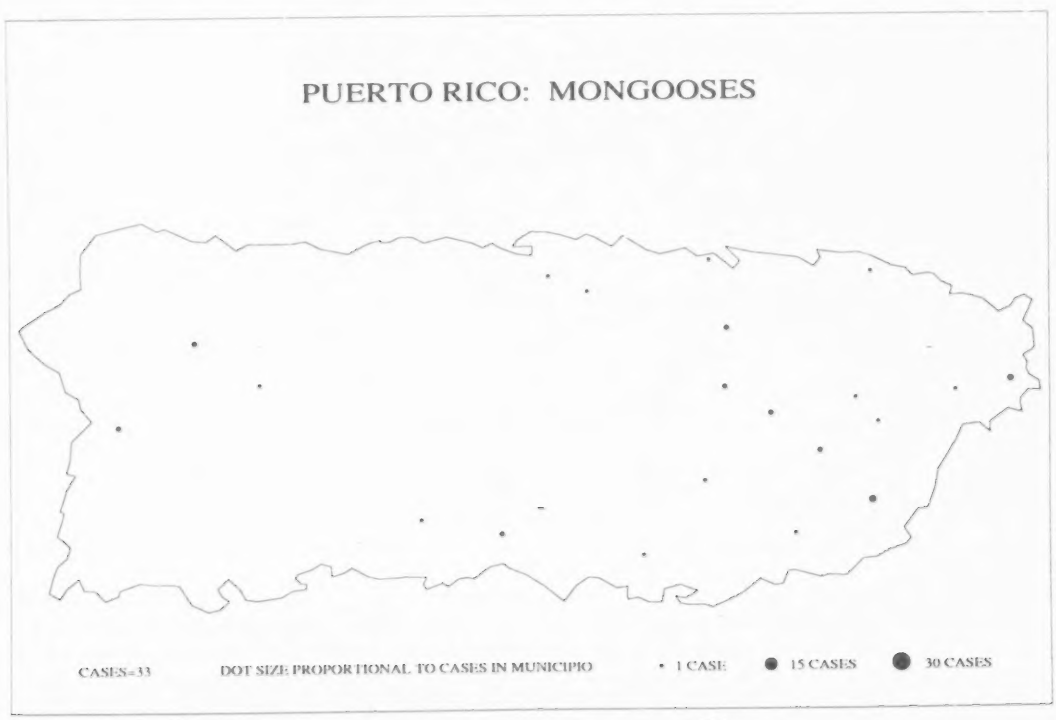


*Figure 8—Reported cases of rabies in mongooses, by municipio, Puerto Rico, 1990.*

*Figure 9—Reported cases of rabies in dogs, by county, 1990.*

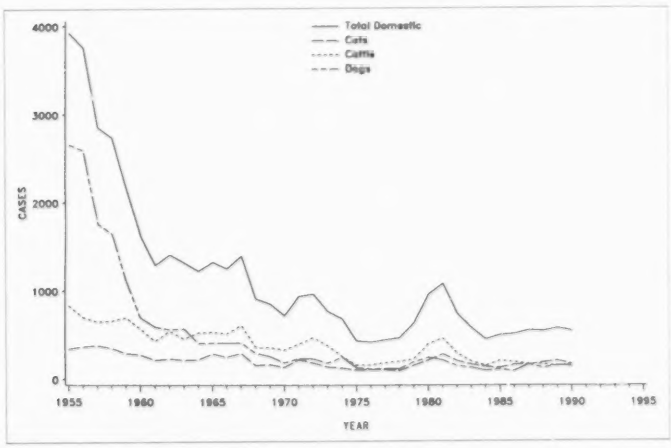


*Figure 10—Cases of rabies in domestic animals in the United States, by year, 1955 to 1990.*

cases), these midwestern states accounted for 31.5% of all reported cases of rabies in skunks. Other states reporting large numbers of rabid skunks were California (230 cases, a decrease of 13.5% from 1989) and Texas (117 cases, a decrease of 49.4%).

*Bats*—The number of reported cases of rabies in bats decreased by 11.5%, from 720 in 1989 to 637 in 1990. Rabies in bats continued to be widely distributed throughout the United States, with cases reported from all but eight of the 48 contiguous states (Fig 6). California again had the largest number of cases (105) in 1990, although this represented a decrease of 10.3% from 1989. New York reported the second largest number of rabid bats (84) in 1990, a 55.6% increase from 1989.

*Other wild animals*—Foxes accounted for 4.6% of all rabies in wild animals in 1990, a decrease of 4.8% from 1989. A rabies epizootic in foxes appears to be reemerging in northern New York, where 34 cases were reported in 1990, compared with none in 1989 (Fig 7). Puerto Rico reported 33 cases of rabies in mongooses, a decrease of 42.1% from 1989 (Fig 8). Other wild animals reported rabid included 25 groundhogs (8 each from New Jersey and Pennsylvania, 4 from Maryland, 2 from Wisconsin, and 1 each from Delaware, Iowa, and

*Figure 11—Reported cases of rabies in cats, by county, 1990.*

*Figure 12—Reported cases of rabies in cattle, by county, 1990.*

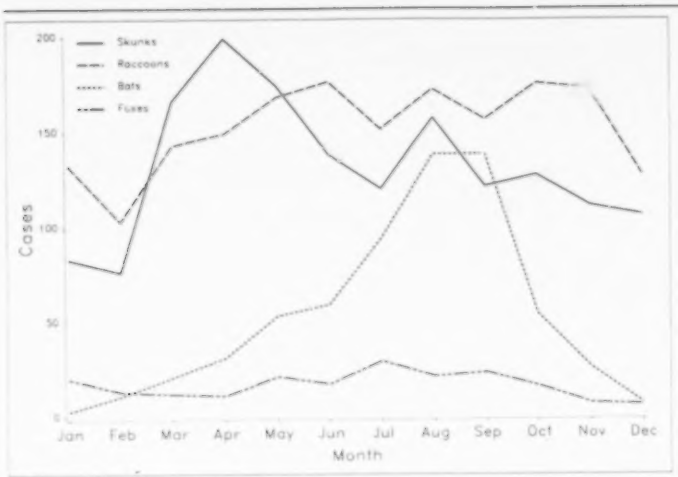


*Figure 13—Cases of rabies in wild animals in the United States, by month, 1990.*

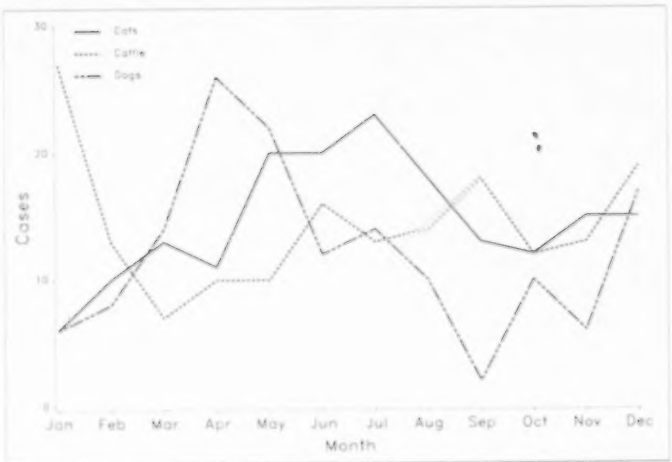


*Figure 14—Cases of rabies in domestic animals in the United States, by month, 1990.*

North Dakota), 15 bobcats, 6 coyotes, 2 deer, 2 otters, 2 opossums, 1 rabbit, 1 squirrel, and 1 shrew.

## Rabies in Domestic Animals

Rabies in domestic animals continued to account for a small proportion (11.3%) of all rabid animals in the United States. With the exception of Texas, rabies in domestic animals tended to be sporadic, with isolated cases in areas endemic for rabies in wildlife. The number of reported rabid domestic animals decreased by 5.3%, from 584 cases in 1989 to 553 in 1990.

*Dogs*—The number of cases of rabies in dogs decreased 7.5%, from 160 cases in 1989 to 148 in 1990. Texas reported the largest number of rabid dogs (40 cases, a decrease of 6.9% from 1989), virtually all of which were attributable to a rabies epizootic in dogs in Starr and Hidalgo counties that began in 1987. Minnesota, Iowa, and South Dakota each reported 11 to 13 cases of rabies in dogs (Fig 9). These states also reported high numbers of rabid skunks.

*Cats*—The number of rabid cats exceeded that of any other domestic animal for the third consecutive year (Fig 10). The 176 cases reported in 1990 represented a 16.9% decrease from 1989 (212 cases). Texas, Oklahoma, and Alabama reported increases in the number of rabid cats in 1990. Other states reporting large numbers of rabid cats include Pennsylvania (34 cases), Iowa (19 cases), Texas (14 cases), Maryland (11 cases), Minnesota (11 cases), and Virginia (11 cases; Fig 11).

*Other domestic animals*—The number of cases of rabies in cattle in 1990 was 173, a 14.6% increase from 1989 (Fig 12). The distribution of rabies in cattle closely followed that of skunks. Iowa reported the largest number of rabid cattle (35), although this was a decrease of 18.6% from 1989. Minnesota (23 cases), North Dakota (17 cases), and South Dakota (31 cases) reported increases in the number of rabid cattle in 1990.

## Seasonality

A number of temporal trends are evident when rabies cases are evaluated among different species by month. The frequency of rabies in skunks peaked in April (199 cases), which was 68 cases more than the monthly mean of 131 for the rest of 1990. Rabies in bats increased steadily, reaching a peak in August and September, each with 138 cases. The frequency of rabies in raccoons had three less distinct peaks in June (176 cases), Oc-

tober (175 cases), and November (172 cases; Fig 13). The frequency of rabies in dogs peaked in April (26 cases), the frequency of rabies in cats peaked in July (23 cases), and the frequency of rabies in cattle peaked in January (27 cases; Fig 14).

### Rabies in a human being

On June 5, 1990, a 22-year-old man died of rabies encephalitis in Hidalgo County, Texas, along the Mexican border. This was the fourth case of rabies in a human being known to be acquired in the United States since 1980 and the first case in Texas since 1985. The man was bitten by a bat that was not submitted for rabies testing and he did not seek medical treatment. Monoclonal antibody typing suggested that the rabies variant was the Mexican free-tailed bat (*Tadarida brasiliensis mexicana*).[4]

### Rabies in Canada and Mexico

Canada reported 2,319 laboratory-confirmed and 172 clinically diagnosed cases of rabies in domestic and wild animals in 1990, a 7.5% increase over the total number of cases in 1989. This increase was attributed to the larger number of reported rabid foxes and cattle (1,167 and 467 cases, respectively), representing increases of 15 and 29.4%, respectively, from 1989. Other species reported rabid were skunks (18.8% of the total), cats (4.3% of the total) and dogs (3.5% of the total). Human cases were not reported from Canada for 1990.

Mexico reported 3,325 laboratory-confirmed and 6,007 clinically diagnosed cases of rabies in domestic and wild animals in 1990. Dogs accounted for 93.5% (8,723 of 9,332) of all reported cases of rabies in animals. Rabies was reported in 69 human beings, an increase of 6.2% from 1989. The majority of these (87%; 60 of 69) had been exposed to rabid dogs.

### Discussion

Among the most important developments in 1990 was the continued spread of the rabies epizootic in raccoons; the epizootic expanded in New Jersey, resulting in a marked increase in reported cases, and entered the state of New York. During 1990, the reported number of cases of rabies in raccoons exceeded that in skunks for the first time. Urban areas provide a suitable habitat for raccoons, and dense populations of human beings and pets in these areas lead to more wildlife encounters that result in submission of wild animals for testing. This epizootic will likely continue to spread to other states in the densely populated New England region. Other important developments include the increase in the total number of cases of terrestrial rabies and the appearance of 34 cases of rabies in foxes in New York, an indication of the reemergence of the epizootic stretching from Canada.

Between 1980 and 1990, 13 cases of rabies in human beings were reported in the United States, but only four (30.8%) of these infections were acquired in the United States. Monoclonal antibody analysis and evaluation of exposure history have demonstrated that 3 of these 4 cases acquired in the United States resulted from exposure to bats.

Bats infected with rabies are found in all regions of the continental United States. During 1990, 43 states reported cases of rabies in bats. Several species are affected, but the Mexican free-tailed bat is the most important vector of rabies in the southwestern states where rabies isolation rates vary from 0 to 5% in bats displaying abnormal behavior.[5]

### 1991 rabies update

The rabies epizootic in raccoons in the mid-Atlantic states has continued to spread within New Jersey and New York and into Connecticut and North Carolina. New Jersey and New York reported 482 and 246 cases of rabies in raccoons during the first 6 months of 1991, respectively. In April 1991, the first case in Connecticut was reported from Fairfield County, and between April and July, 22 cases of rabies in raccoons were reported. In addition, the first case in North Carolina was reported from Gates County in April, 1991.

Three cases of rabies in human beings in the United States were reported to the CDC in 1991. Two of these cases were reported in August, one was a 55-year-old woman from Starr County in Texas and the other was a 29-year-old man from Clark County, Arkansas. The third case, reported in October, was a 27-year-old woman from Walker County, Georgia. Monoclonal antibody typing suggested that the rabies variants from the Arkansas and Georgia patients were that commonly found in the silver-haired bat (*Lasionycteris noctivagans*). Although exposure to rabies was not reported for the woman from Texas, a variant consistent with the Mexican dog or coyote strain was isolated from her saliva, and she lived in one of the two counties in the United States where rabies continues to be transmitted from dog to dog. The Arkansas man had had contact with a bat (not submitted for testing) and he did not seek antirabies prophylaxis. The woman from Georgia had no known contact with a bat.

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